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Title: FUEL FEED APPARATUS HAVING CONDUCTIVE MEMBERS GROUNDED EACH

VERIFIED TRANSLATION OF PRIORITY DOCUMENT

The undersigned, of the below address, hereby certifies that he/she well knows both the English and Japanese languages, and that the attached is an accurate translation into the English language of the Certified Copy, filed for this application under 35 U.S.C. Section 119 and/or 365, of:

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[Title of the Invention] FUEL FEED APPARATUS

[Scope of Claims]

[Claim 1]

A fuel feed apparatus comprising:

a sub tank included in a fuel tank;

a fuel pump, included in the sub tank, for sucking fuel in the sub tank so as to discharge the fuel; and

a jet pump having a jet nozzle and a fuel inlet port for sucking fuel in the fuel tank by suction pressure generated by fuel discharged from the jet nozzle so as to supply the fuel to the sub tank,

wherein, the sub tank is resinous and conductive.

[Claim 2]

A fuel feed apparatus according to claim 1, wherein the jet pump is resinous and conductive.

[Claim 3]

A fuel feed apparatus according to claim 1 or 2, wherein the jet nozzle and the fuel inlet port directly connect with the sub tank.

[Claim 4]

A fuel feed apparatus according to any one of claims 1 to 3, wherein the jet pump is provided in a bottom area of the sub tank.

[Claim 5]

A fuel feed apparatus according to any one of claims 1 to 4, further

comprising:

a fuel filter for removing debris contained in fuel discharged by the fuel pump; and

a pressure regulator for adjusting pressure of fuel flowing from the fuel filter and supplying surplus fuel generated by adjusting pressure to the jet nozzle.

[Claim 6]

A fuel feed apparatus according to claim 5,

wherein the fuel filter is connected with the sub tank, and

the fuel filter includes a grounding terminal.

[Claim 7]

A fuel feed apparatus according to any one of claims 1 to 6, further comprising:

a mounting member mounted on the fuel tank;

a supporting member having conductivity connected with the sub tank;

a metallic joining member, for connecting the mounting member and the supporting member; and

a metallic forcing member provided around an outer periphery of the joining member for applying force in a direction, in which the supporting member and the sub tank depart from the mounting member.

[Claim 8]

A fuel feed apparatus comprising:

a sub tank included in the fuel tank;

a fuel pump, included in the sub tank, for sucking fuel in the sub tank so as to discharge the fuel; and

a jet pump having a jet nozzle and a fuel inlet port for sucking fuel in the fuel tank by suction pressure generated by fuel discharged from the jet nozzle so as to supply the fuel to the sub tank,

wherein the jet pump is resinous and conductive.

[Technical Field]

[0001]

The present invention relates to a fuel feed apparatus where fuel is supplied into a sub tank by a jet pump and sucked by a fuel pump to be discharged.

[Background Art]

[0002]

As generally known, an in-tank type fuel feed apparatus is disposed in a fuel tank for sucking fuel in the fuel tank and discharging the fuel. In such a fuel feed apparatus, fuel is apt to be charged with static electricity caused by friction between fuel discharged by a fuel pump in the fuel feed apparatus and one of a fuel outlet pipe and a filter element in a fuel filter. When fuel discharged by the fuel pump is charged, passage members defining a fuel passage downstream of the fuel pump and peripheral members are charged.

[0003]

When a charged nonconductive member discharges its static

electricity, the discharge becomes corona discharge having low discharge energy. However, if the charged nonconductive member exists near a non-grounded conductive member, an induction charge arises in the non-grounded conductive member. If a conductive member, in which induction charge is caused, is located near another conductive member, a spark may be caused between the conductive members, regardless whether the other conductive member is grounded or not. Such a spark between the conductive members is apt to be caused in a condition such as low temperature, low vapor pressure of fuel, and A/F (air fuel ratio) becomes high in an ignition zone, for example. Besides, if a charge amount increases in a nonconductive member, the nonconductive members may cause dielectric breakdown, consequently, a crack may be caused from the section where the dielectric breakdown is caused.

[0004]

[Patent Document 1] JP-A-11-324840

[0005]

As generally known, in an in-tank type fuel feed apparatus, a fuel feed pump is disposed in a sub tank accommodated in a fuel tank such that a liquid level in the sub tank is controlled so that the fuel pump can suck fuel even if the liquid level in the fuel tank is decreased. In such a fuel feed apparatus, surplus fuel of return fuel returned from an engine and fuel discharged from a fuel pump is supplied to a jet pump. Fuel inlet port of the jet port sucks fuel in the fuel tank by negative pressure, which is lower than ambient pressure, generated when the fuel is jetted from a jet nozzle of the jet pump, so that fuel in the fuel

tank is supplied into the sub tank through the fuel inlet port together with jetted fuel.

[0006]

[Problems that the Invention is to Solved]

When the jet nozzle jets fuel, friction and static charge arise between the jetted fuel and the jet nozzle and between the sucked fuel and the fuel inlet port. When the jet nozzle of the jet pump and the fuel inlet port are nonconductive, charging mount of the jet pump may increase. When a non-grounded conductive member is in the vicinity of the jet pump, which is charged, induction charge is caused in the conductive member. As described above, if a conductive member, in which induction charge is caused, is located near another conductive member, a spark may be caused between the conductive members, regardless whether the other conductive member is grounded or not.

It is an object of the present invention to propose a fuel feed apparatus where a jet pump is prevented from charging with static electricity.

[0007]

[Means for Solving the Problems]

According to the fuel feed apparatus defined by claims 1 to 4 of the present invention, the sub tank is resinous and conductive. The sub tank has a large surface area, and grounding position can be freely selected, thereby being readily grounded. Therefore, regardless whether the jet nozzle and the fuel inlet port are conductive or non conductive, the jet pump can be readily grounded via the sub tank, so that the jet pump can be prevented from charging

with electricity. Besides, the jet pump is prevented from causing a crack from a section where the dielectric breakdown is caused due to increase in a charge amount in the jet pump.

[0008]

According to the fuel feed apparatus defined by claim 2 of the present invention, the jet pump is resinous and conductive, so that the jet pump can be readily grounded via the sub tank. Therefore, the jet pump can be prevented from charging with electricity.

According to the fuel feed apparatus defined by claim 3 of the present invention, the jet nozzle and the fuel inlet port directly connect with the sub tank, so that a member electrically connecting the jet nozzle, which constructs the jet pump, with sub tank is not necessary.

[0009]

According to the fuel feed apparatus defined by claim 5 of the present invention, when fuel passes through the fuel filter, the fuel is charged with electricity due to friction relative to the filter element. Consequently, the charged fuel is jetted from the jet pump, and the jet pump is apt to be charged with electricity. However, the jet pump can be grounded via the sub tank, so that the jet pump can be prevented from charging with electricity.

According to the fuel feed apparatus defined by claim 6 of the present invention, the fuel filter connecting with the sub tank includes a grounding terminal. The jet pump can be grounded via the sub tank and the fuel filter, so that the jet pump can be prevented from charging with electricity.

[0010]

According to the fuel feed apparatus defined by claim 7 of the present invention, the metallic joining member and forcing member, which are conductive, can be readily grounded via the supporting member and the sub tank, which are conductive. Therefore, the metallic joining member and forcing member can be prevented from charging with electricity.

According to the fuel feed apparatus defined by claim 8 of the present invention, the jet pump is resinous and conductive, so that the jet pump can be prevented from charging with electricity.

[0011]

[Embodiment of the Invention]

As follows, an embodiment of the present invention is described in reference to figures. FIG. 1 depicts a fuel feed apparatus according to one embodiment of the present invention. A resinous flange member 11 of a fuel feed apparatus 10 is mounted on a top wall of an unillustrated resinous fuel tank. Other members of the fuel feed apparatus 10 are accommodated in the fuel tank. The flange member 11 is used as a mounting member. An outlet pipe 12, an electric connector 13 and a vent valve 14 are built on the flange member 11. The outlet pipe 12 is for supplying fuel discharged from a fuel pump 40 to outside the fuel tank. The fuel pump 40 is disposed in a sub tank 20. The outlet pipe 12 is connected with a pressure regulator 60 via a flexible tube 19. The pressure regulator 60 is provided on an outlet side of the fuel pump 40. The electric connector 13 supplies electric power of the fuel pump 40, and

outputs a detection signal of a level sensor 70. The electric connector 13 further has a grounding terminal for grounding the fuel feed apparatus 10. An electric part of the fuel pump 40, a grounding terminal 56 provided in the fuel filter 50, and the level sensor 70 are connected with the electric connector 13 via lead wires 15. The air vent valve 14 is for exhausting inside air of the fuel tank to outside the fuel tank when fuel increases in the fuel tank.

[0012]

A stay 30 is used as a supporting member. Claws 32 of the stay 30 fit on a stick-shaped fitting section 22 of the sub tank 20 so that the stay 30 is joined with the sub tank 20. The flange member 11 and the stay 30 are coupled together with a metallic pillar 16 made of stainless steel or ferrous material. The metallic pillar 16 is used as a connecting member. One end of the pillar 16 is inserted into a bottomed cylindrical member (not shown) formed in the flange member 11. The other end of the pillar 16 is inserted into a cylindrical section 33 in the stay 30. The sub tank 20 and the stay 30 are jointly movable with respect to the pillar 16 in the longitudinal direction of the pillar 16. A coil spring 18 is used as a forcing member, and is made of stainless-steel or ferrous material as the pillar 16 is. The coil spring 18 is press-inserted into the cylindrical section 33. The coil spring 18 presses the cylindrical section 33 of the stay 30 downwardly from the flange member 11 toward the sub tank 20, i.e., toward a bottom of the fuel tank 1. Accordingly, the bottom face of the sub tank 20 is pressed onto the inner bottom face of the fuel tank 1 when the fuel feed apparatus 10 is mounted on the fuel tank 1. In

this structure, the bottom section of the sub tank 20 is subjected to force by the coil spring 18 so as to be constantly pressed onto the inner bottom face of the fuel tank 1 regardless of expansion or shrinkage of the resinous fuel tank 1 due to changing inner pressure caused by temperature variation and changing amount of fuel in the fuel tank 1.

[0013]

The sub tank 20 is made of resin, and has conductivity. A fuel inlet pipe 26 of the jet pump 24 is integrally formed on the bottom section of the sub tank 20 with the same resin same as the sub tank 20. A check valve 28 is provided in a fuel outlet port of the fuel inlet pipe 26 for preventing fuel from flowing in reverse direction from inside the sub tank 20 toward the jet pump 24.

[0014]

The jet pump 24 has a jet nozzle 25 and the fuel inlet pipe 26. The jet nozzle 25 is joined on the outer bottom face of the sub tank 20 by welding or the like, and has a nozzle port 25a for jetting fuel. The jet nozzle 25 is made of resin, and has conductivity. As described above, the fuel inlet pipe 26 is formed of the same resin same as the sub tank 20, and is integrally formed with the sub tank 20, thereby having conductivity. Surplus fuel is exhausted from the pressure regulator 60, and the surplus fuel is jetted from the nozzle port 25a of the jet nozzle 25 toward the fuel inlet pipe 26 so that suction pressure (i.e., negative pressure lower than ambient pressure) is generated around the jetted surplus fuel. Fuel in the fuel tank is sucked into the fuel inlet pipe 26 by the suction pressure, and the fuel is fed into the sub tank 20 through the fuel inlet

pipe 26.

[0015]

As shown in FIG. 2, the fuel pump 40 is horizontally disposed in the sub tank 20, and sucks fuel inside the sub tank 20 through a suction filter 48. The fuel pump 40 discharges the fuel, which is sucked from inside of the sub tank 20 through the suction filter 48, through a discharge port 42. A ball 43 is provided as a check valve on a downstream side with respect to the discharge port 42. The ball 43 prevents fuel from flowing in reverse direction from the discharge port 42 toward the inside of the fuel pump 40.

[0016]

A fuel filter 50 includes a filter case 52 and a filter element 55 accommodated in the filter case 52. An inlet port 53 of the filter case 52 is fitted to the discharge port 42 of the fuel pump 40. The fuel filter 50 is horizontally provided in the sub tank 20, and covers upper periphery of the fuel pump 40. The filter case 52 of the fuel filter 50 is snap-fitted to the sub tank 20 and the fuel pump 40. Debris is removed from fuel discharged from the fuel pump 40 by the filter element 55. The grounding terminal 56 is provided in the filter case 52. The grounding terminal 56 is electrically connected with a grounding terminal of the electric connecter 13 via the lead wires 15. Therefore, the fuel filter 50 is grounded via the electric connector 13.

[0017]

The inlet port 62 of the pressure regulator 60 fits to the outlet port 54 of the filter case 52. The pressure regulator 60 adjusts pressure of fuel flowing

from the inlet port 62 after removal of debris by the fuel filter 50. The fuel flowing from the inlet port 62 is subjected to pressure adjustment by the pressure regulator 60. The pressure-adjusted fuel from the pressure regulator 60 is supplied to outside of the fuel tank from an outlet port 64 through the flexible tube 19 and the outlet pipe 12. Surplus fuel, which is generated while pressure of the fuel is adjusted by the pressure regulator 60, is exhausted through an outlet port 66, and is jetted from the jet nozzle 25 of the jet pump 24.

The level sensor 70 measures amount of fuel inside the fuel tank by rotation of a float 72 in accordance with a level of fuel in the fuel tank.

[0018]

In this embodiment, the jet nozzle 25 and the fuel inlet pipe 26 are made of conductive resin, and is directly joined with the conductive sub tank 20. The sub tank 20 is snap-fitted to the fuel filter 50. The fuel filter 50 is grounded via the grounding terminal 56 provided in the filter case 52. Therefore, the jet nozzle 25 and the fuel inlet pipe 26 are grounded via the sub tank 20, the fuel filter 50, and the grounding terminal 56. Even when the surplus fuel exhausted from the pressure regulator 60 is jetted from the jet nozzle 25 of the jet pump 24 toward the fuel inlet pipe 26, and static electricity is caused by friction between the jetted fuel and the jet nozzle 25, and between sucked fuel and the fuel inlet pipe 26, the jet nozzle 25 and the fuel inlet pipe 26 can be prevented from charging with electricity. Besides, even when fuel charged while passing the filter element 55 is supplied to the jet nozzle 25 after passing through the fuel pump 50 and the pressure regulator 60, the jet nozzle 25 and the fuel inlet pipe

26 can be prevented from charging with electricity. Therefore, the jet nozzle 25 and the fuel inlet pipe 26 can be prevented from causing dielectric breakdown due to increase of its charge amount, thereby being prevented from cracking resulting from the dielectric breakdown.

[0019]

The stay 30 is made of conductive resin, and is joined with the sub tank 20 via the fitting section 22 and the claw 32. Furthermore, the pillar 16 is inserted into the cylindrical section 33 of the stay 30, thereby contacting with the cylindrical section 33. Therefore, the pillar 16 and the coil spring 18 are grounded via the stay 30, the sub tank 20, the fuel filter 50 and the grounding terminal 56. Thus, the metallic pillar 16 and the metallic coil spring 18 can be prevented from charging.

[0020]

In the above embodiment of the present invention, surplus fuel of the pressure regulator 60 is jetted through the jet nozzle 25. Alternatively, return fuel returning from the engine to the fuel tank may be jetted through the jet nozzle 25. In this case, a fuel filter can be provided outside the fuel tank as an individual member, not surrounding the outer periphery of the fuel pump 40 in the fuel tank.

[0021]

In the above embodiment, the jet nozzle 25 and the fuel inlet pipe 26 are directly connected with the sub tank 20, so that the jet nozzle 25 and the fuel inlet pipe 26 are electrically connected directly with the sub tank 20, without

using another member. Alternatively, the jet nozzle and the fuel inlet pipe may be electrically connected indirectly with the sub tank 20 via another member.

[0022]

In the above embodiment, the sub tank 20, the jet nozzle 25, and the fuel inlet pipe 26 are conductive resinous member. However, the sub tank can be a non-conductive resinous member. The jet nozzle and the fuel inlet pipe may be conductive resinous members. Even when the jet nozzle is made to be non-conductive, the jet pump including the jet pump and the fuel inlet pipe can be prevented from charging by electrically connecting the jet nozzle and the fuel inlet pipe with a vicinity conductive member, thereby grounding, because the jet nozzle and the fuel inlet pipe are conductive.

Of course, the sub tank 20, the jet nozzle 25 constructing the jet pump 24, or the fuel inlet pipe 26 may be directly grounded. One of the jet nozzle and the fuel inlet pipe may be conductive, and the other may be non-conductive.

[0023]

In the above embodiment, the fuel pump 40 is vertically arranged. However, the fuel pump 40 may be horizontally arranged. In this case, a member corresponding to the stay 30 of the present embodiment may not be exist. However, the pillar and the coil spring can be prevented from charging by grounding a conductive member, with which the pillar and the coil spring directly contact, similarly to the stay 30 of the embodiment, instead of the stay 30.

[Brief Description of the Drawings]

[FIG. 1]

FIG. 1 is a partially cross-sectional side view showing a fuel feed apparatus according to an embodiment of the present invention.

[FIG. 2]

FIG. 2 is an explanation view showing a fuel flow according to the embodiment.

[Description of Reference Numerals and Signs]

10 fuel feed apparatus

11 flange member (mounting member)

16 pillar (joining member)

18 coil spring (forcing member)

20 sub tank

24 jet pump

25 jet nozzle

26 fuel inlet pipe (fuel inlet port)

30 stay (supporting member)

40 fuel pump

50 fuel filter

52 filter case

55 filter element

56 grounding terminal

60 pressure regulator

[Designation of Document] Abstract

[Abstract]

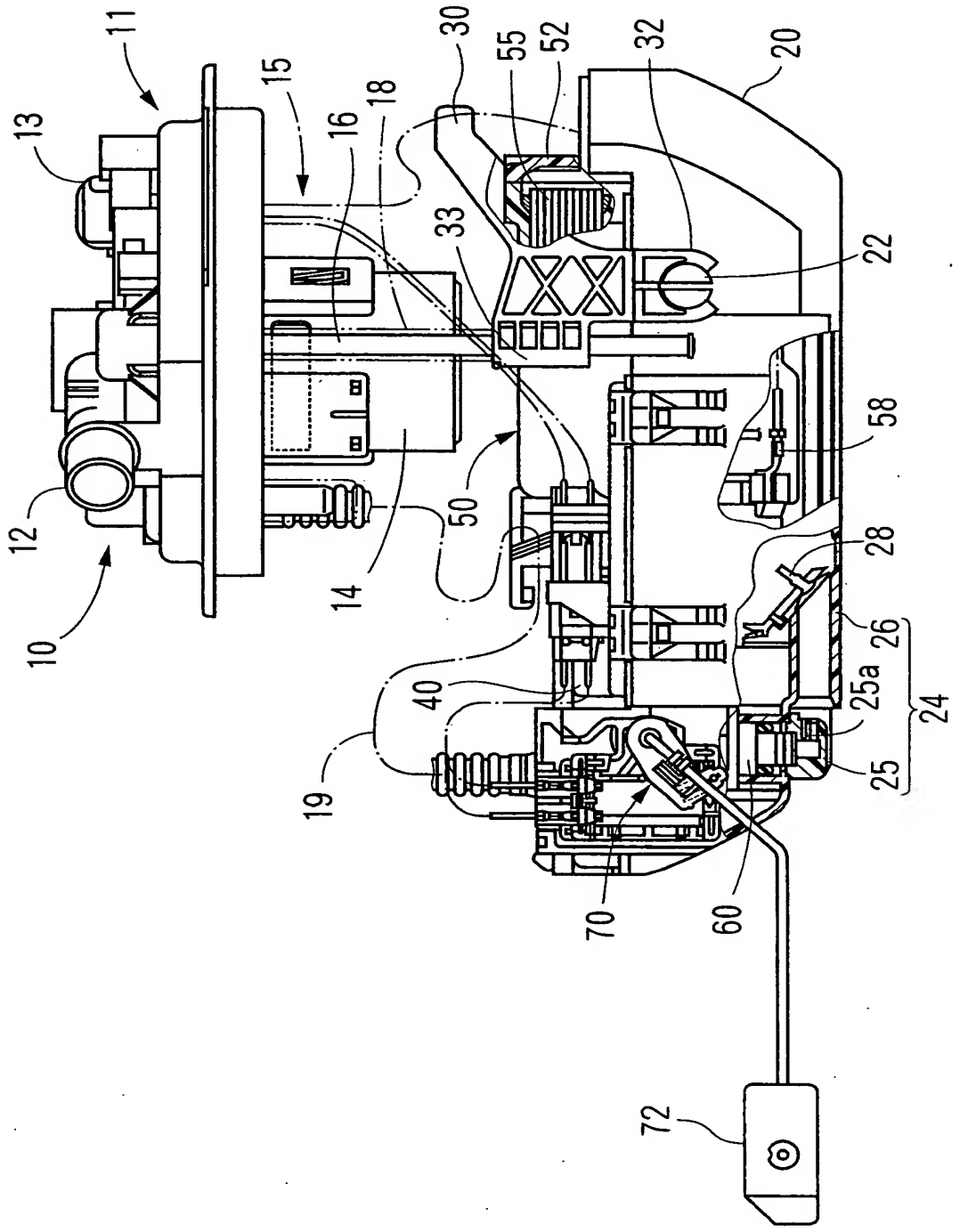
[Problem] To produce a fuel feed apparatus preventing a jet pump from charging

[Means for Resolution] A sub stank 20 is resinous and conductive. A jet nozzle 25 of a jet pump 24 is joined with a bottom outer wall of the sub tank 20 by welding or the like, and has a nozzle port 25a for jetting fuel. A fuel inlet pipe 26 of the jet pump 24 is formed of resin same as the sub tank 20 in a bottom of the sub tank 20 integrally with the sub tank 20, and is conductive. Suction pressure, which is lower than ambient pressure is generated around the jetted fuel by jetting surplus fuel exhausted from a pressure regulator 60 toward the fuel inlet pipe 26 through the nozzle port 25a of the jet nozzle 25. The fuel inlet pipe 26 sucks fuel in the fuel tank by this suction pressure, so that fuel is supplied into the sub tank through the fuel inlet pipe 26.

[Selected Drawing] FIG. 1

【書類名】DESIGNATION OF DOCUMENT 図面 DRAWING

【図１】FIG. 1



【図２】FIG.2